UNIVERSITY OF ALBERTA

Water Management Plan

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1. Introduction

The University of Alberta is a globally recognized leader in post-secondary education and research, and a leader in sustainability[1,2,3]. The university develops strategies to conserve resources, decrease the production of waste, minimize ecological footprints, decrease greenhouse gas emissions, and build a culture of sustainability at the institution and in the greater community of which it is a part.

The University of Alberta's Facilities and Operations (FO) department is committed to reducing its impact on the environment. Substantial contributions have been made to this effort for decades through the energy management program, which also includes reductions in water used for heating and cooling across campus. It is recognized that water, energy, and greenhouse gas emissions are intrinsically linked–the consumption of water drives up energy use and greenhouse gas production. The university is always looking for other opportunities to enhance its commitment to sustainability and considering the university's water use is a natural step.

Regional Context

The University of Alberta resides on the banks of the North Saskatchewan River, whose watershed is the sole supply of water for the university and the City of Edmonton. Two water treatment plants—EPCOR'S E.L. Smith Water Treatment Plant and the Rossdale Water Treatment Plant—take in water, clarify, filter, disinfect, and then transfer it to reservoirs that supply potable water to the city and its various customers, including to the U of A[4].

On North Campus, the University of Alberta's Utilities department manages an extensive storm and sanitary system that captures and carries water from the university's buildings and grounds. Wastewater from the U of A's Edmonton campuses is treated at EPCOR's Gold Bar Wastewater Treatment Plant and then returned to the North Saskatchewan River. The water then continues to travel through Saskatchewan to the Hudson Bay, via the Nelson River[5].

[1] Times Higher Education Impact Rankings. https://www.timeshighereducation.com/impactrankings#!/page/6/length/10/sort_by/rank/sort_order/asc/cols/undefined. Accessed September 29, 2021.
[2] University of Alberta "University Rankings in Canada" web page. https://www.ualberta.ca/about/university-rankings-in-canada/index.html.Accessed September 29, 2021.
[3] AASHE STARS Ratings. https://stars.aashe.org/institutions/participants-and-reports/?sort=rating. Accessed January 15, 2017.
[4] EPCOR. (2014). *How Water Gets To Your Home*. https://www.epcor.com/learn/how-it-works/Pages/how-water-gets-to-your-home.aspx. Accessed October 6, 2021.
[5] City of Edmonton. (2010). *Edmonton's Water Supply*. http://www.edmonton.ca/city_government/documents/Discussion_Paper_3_Water_Supply.pdf. Accessed October 6, 2021.

The U of A must follow the City of Edmonton EPCOR Drainage Services Bylaw[6] which details responsibilities of EPCOR and its customers with respect to drainage infrastructure, permitted and prohibited wastewater releases (and definitions of each category of prohibited, restricted and hazardous waste), and water release reporting requirements.

In 2005, the North Saskatchewan Watershed Alliance studied the health of the watershed by investigating water quality, water quantity, biological indicators, and surrounding land use. On a scale of excellent, good, fair, and poor it was determined that the overall health of the watershed is generally "fair", and the watershed's health decreases in areas where land use is more intensive, more specifically downstream of Edmonton[7].

Benefits of a Water Conservation Initiative

As the population of the university grows, larger demands will be placed on water resources. Striving to decrease consumption will result in environmental, social, and economic benefits for the university and the Edmonton region. The University of Alberta is motivated to be a leader in resource conservation within the Edmonton region and across Canada. Implementing formal water management measures will demonstrate the university's dedication to resource conservation and social responsibility.

Environmental Benefits

- Less water drawn from lakes and rivers
- Less wastewater production and decreased demand for treatment of wastewater
- Reduced GHG emissions and energy use from wastewater treatment
- Less chemicals produced for treatment
- Less industrial waste because of treatment
- Lowered instances of land erosion due to agricultural and irrigation requirements
- Less habitat degradation due to fewer surface water withdrawals
- Preservation of wetlands which filter pollutants
- Lessened impacts on species at risk, and species in general, due to wastewater and treatment facilities
- Moving from bottled water consumption to treated tap water, reducing waste
- Improved carbon storage due to maintaining wetland health
- Less need for water to be transported over long distances
- Lower energy and GHGs because of decreased pumping and mechanical system operations required for the entire life cycle of the water

[6] City of Edmonton Bylaw 18100 Epcor Drainage Services Bylaw. Consolidated February 19, 2020. https://cityarchives.edmonton.ca/bylaw-18100. Accessed October 6, 2021. Note Article 5 and Appendices A, B, and C regarding wastewater releases.
[7] North Saskatchewan Watershed Alliance. (2005). The State of the North Saskatchewan Watershed Report. https://www.nswa.ab.ca/resource/the-state-of-the-north-sask-river-watershed-report/. Accessed November 1, 2021.

Social Benefits

- Establishes the university's commitment to sustainability of the surrounding community and region
- Less impact on livelihood of farmers/producers/retailers during drought conditions
- Lessened likelihood of disputes over water distribution during extreme drought conditions
- Higher standard of living and health due to easier access to potable water
- Higher air quality due to mitigation of environmental degradation
- Healthy watersheds that aid in reduction of flood impacts
- Preservation of First Nations culture which is profoundly tied to water for both physical and spiritual health
- Greater community involvement in water initiatives and watershed protection
- Increased understanding about the benefits and savings associated with treated tap water

Operational Efficiencies (Economic Benefits)

- Reduced purchases of raw or finished water
- Reduced operations and maintenance costs
- Fewer/downsizing of new facilities in terms of water needs
- Cost-savings related to reduced energy use associated with water-related operations
- Less wear and tear on the municipal equipment that carries and filters water
- Reduce need for management of disposable beverage containers

Cost of Not Conserving

Beyond considering the benefits to water conservation, it is also important to take the costs of not conserving into consideration. At this time, water in the region is not a major issue. As population continues to expand—and with the increasing stress of climate change—it is important that we prepare ourselves to handle water scarcity. By implementing forward-thinking initiatives and adopting new practices and infrastructure now, we give ourselves a head start in responding to future issues.

By failing to be proactive on water conservation, we risk the University of Alberta losing its status as an institution which values sustainability and is committed to continuous improvement of sustainability practices.

History of Water at the University of Alberta

Between the beginning of fiscal year 1975/1976 and 2017/2018, the University of Alberta's water consumption has decreased by 54 per cent, while building area has increased by 80 per cent. During the same period, water use intensity (the amount of water used per square meter of building space), has decreased by 74 per cent, indicating university processes have become more water efficient. Further investigation through water audits show evidence of opportunities

for continued reduction that could be achieved through a program dedicated to water stewardship.

Setting the stage for continued water reductions at U of A

Concerns about energy usage, environmental impacts, climate change, and increasing utility costs are increasingly adding pressure to establish significant resource reduction opportunities including water and its corresponding energy nexus.

At U of A specifically:

- Heavier energy demands are being placed on existing facilities with respect to occupancy and usage, and facilities are continually becoming more equipment intensive.
- Systems are required to run for longer hours including increased usage after normal hours to meet the increased demands being placed on facilities.
- Upgrading funds are not keeping pace with the decay of facilities. Facilities and systems are continually aging and decaying with subsequent loss of efficiency and increased water and overall energy consumption.

We are not immune to utility rate increases and have no control over the water available in the North Saskatchewan River that influences them. However, through vigilance in our water conservation efforts we can exercise control over our consumption, thereby increasing the security and decreasing the cost of our utility bill and reducing our impact on the environment. Through the water management program, the University of Alberta aims to proactively protect the water supply in the North Saskatchewan River Basin and contribute to a secure water future for the university and beyond.

2. Water Management Plan Overview

Watego: Proactive Water Protection

The Energy Management and Sustainable Operations (EMSO) unit within Facilities and Operations (F&O) is responsible for planning and implementing water reductions. This contributes to EMSO's core objective of reducing the university's utility consumption and greenhouse gas (GHG) emissions. EMSO strives to ensure that:

- previous gains are built upon,
- water and energy bills are as low as practical,
- water and energy are used efficiently to reduce consumption of non-renewable resources,
- environmental impacts are reduced, and
- the university is developed and operated in a sustainable manner.

With much reflection on past initiatives and successes, EMSO broke water management out from under its long-standing energy management program in 2014 and launched *Watego: Proactive Water Protection*. This program is a university wide water stewardship program focused on contributing to a sustainable water future for Albertans and all those living in the North Saskatchewan River basin.

Watego initiatives may include:

- Water use reductions through fixture upgrades (e.g. water closet fixtures)
- Enhancing water metering infrastructure
- Lab upgrades
- Pilots of innovative technologies and on-campus research projects
- Exploration of water reuse opportunities, including greywater reuse[8]
- Behaviour change campaigns
- Support for campus community led water reduction projects

To implement this program, EMSO will work directly with other units within F&O to plan projects to align with the deferred maintenance schedule. Additionally, EMSO will collaborate with other university departments as necessary (e.g., lab updates, innovative projects).

Strategic Alignments

Greenhouse Gas Emissions Reduction Plan and Energy Reduction Master Plan

The flow of water, whether through a forest, river ecosystems, or human built environments, creates complex interconnections among people, places and issues. This interconnectedness is

8 For example, U of A researcher Nicholas Ashbolt researches water reuse and public health, and informed the recent creation of a set of "Public Health Guidelines for Water Reuse and Stormwater Use" released by Alberta Health Services to inform and guide water reuse projects in Alberta. https://open.alberta.ca/publications/public-health-guidelines-water-reuse-stormwater-use. January 2021. Accessed November 8, 2021.

often viewed as a major challenge in addressing environmental issues because of the many values, interests and actors at play. But this interconnectedness also provides opportunities. For water, the opportunities lie in the interconnections between water and energy, and the related climate change implications.

The story of these interconnections – often referred to as the "water–energy nexus" – has two sides. Huge amounts of water are required to generate energy - to power the turbines in hydro-electric facilities, for cooling in thermal or nuclear energy plants, and to extract oil from Alberta's oil sands. Collectively, the energy sector is the single largest user of water in Canada[9]. At the same time, large amounts of energy are required to pump, treat and distribute water for urban, industrial and agricultural use and to deal with the resulting wastes. Together, the two sides of this story are generating new research, policy proposals and public dialogue that will be critical as societies struggle to address the intersecting challenges of climate change, energy security and water scarcity[10].

This plan focuses on the energy used for water provision as it relates to urban water services by specifically addressing the energy required to deliver water to, within and from our communities, to remove contaminants from water and wastewater, and to heat water to meet the university's needs.

The water-energy nexus is deeply embedded within the context of climate change, a concern that is front and centre for many Canadians. Burning fossil fuels to generate electricity and heat for provision of water services creates GHG emissions. A discussion of the energy associated with water use and the potential for related efficiencies is therefore necessarily a discussion of climate change and the potential for mitigation of greenhouse gas emissions.

Thus by working to reduce water use, we are contributing to the objectives of the university's Energy Reduction Master Plan and Greenhouse Gas Emissions Reduction Plan.

University of Alberta Integrated Asset Management Strategy "Taking Care of our Campuses"

Taking Care of our Campuses[11] sets the direction for the University of Alberta's infrastructure assets, while defining a long-term roadmap, and emphasizes that all students, staff, faculty, visitors, and members of the university community have an important role to play as stewards of the university's buildings and grounds.

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[9] Environment Canada. (2016). *Canadian Environmental Sustainability Indicators: Water withdrawal and consumption by sector*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/water-withdrawal-consumption-sector.html. Accessed November 1, 2021.

[10] Maas, C. (2009). *Greenhouse Gas and Energy Co-Benefits of Water Conservation*. POLIS Research Report, 09-01. Retrieved from https://poliswaterproject.org/polis-research-publication/greenhouse-gas-energy-co-benefits-water-conservation/. Accessed November 1, 2021.

[11] University of Alberta Integrated Asset Management Strategy 2019-2035 "Taking Care of our Campuses". https://www.ualberta.ca/facilities-operations/strategy/asset-management-strategy/index.html. Accessed October 6, 2021.

- Principle 7: Social, economic and environmental sustainability is achieved by incorporating inclusive design principles into campus infrastructure (e.g. all-gender, barrier-free), reducing our ecological footprint, reducing operational costs, and continually advancing the three pillars of sustainability: social, economic and environmental.
- Goal 5: Optimize operations to strategically re-invest funding to maintenance programs and/or capital renewal efforts to better manage the growing deferred maintenance liability.
- Action 5d: Advance sustainable operations' practices to support sustainability and environmental targets.

The University of Alberta's Institutional Strategic Plan "For the Public Good"

In addition to the strategic approach of the program itself, *Watego* will help advance several of the goals and strategies set out in the Institutional Strategic Plan[12].

- Objective 6/Strategy 2: "Engage and advocate strategically with all levels and orders of government and other key stakeholders, and identify and demonstrate how university activities intersect with their goals and their strategies."
- O6/S3: "Communicate, using both quantitative and qualitative evidence, how the University of Alberta serves as a cornerstone of the community bringing widespread economic and societal benefits to all Albertans, as well as to national and international partners and stakeholders."
- O16/S3: "Engage with government, community, industry, business and the post-secondary sector to address shared local, provincial, national and global challenges."
- O20/S2: "Embed social, economic, and environmental sustainability into the development and care of the university's natural and built environments."
- O21/S5: "Develop a set of equitable, meaningful and relevant measures to monitor our progress toward strategic goals and develop the tools required to report on them."
- O23/S1: "Secure and sustain funding to plan, operate, expand, renew and optimize the use of campus infrastructure to meet evolving teaching and research priorities."

UN Sustainable Development Goals

The 17 United Nations Sustainable Development Goals (SDGs)[13] are part of the 2030 Agenda for Sustainable Development that was adopted by UN Member States in 2015. The SDGs are an urgent global call to action to end poverty, improve health and education, reduce inequality, encourage economic growth, tackle climate change and protect the environment.

- SDG 6 Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all

[12] University of Alberta's Institutional Strategic Plan "For the Public Good". 2016. https://www.ualberta.ca/strategic-plan/index.html. Accessed October 6, 2021.
[13] United Nations Sustainable Development Goals. https://sdgs.un.org/goals. Accessed October 6, 2021.

- SDG 9 Industry, Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- SDG 13 Climate Action: Take urgent action to combat climate change and its impacts
- SDG 14 Life Below Water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- SDG 15 Life on Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Scope of the Water Management Plan

The University of Alberta has five campuses and several research stations. This plan focuses mainly on North Campus and will eventually expand to other campuses and research stations that are directly operated and maintained by the university's Facilities and Operations (FO) department, as well as some Campus Services facilities.

Key Collaborations

The EMSO unit within FO is responsible for the implementation of the Water Management Plan but EMSO does not work in isolation. The success of the Water Management Plan requires constant and productive collaboration with other units within FO who are involved in building and maintaining the university's physical infrastructure.

3. Technology Selection and Implementation

Significant components of *Watego's* initiatives include water metering, water audits, and retrofitting buildings with water-efficient fixture and equipment alternatives.

All buildings on North Campus have water meters that are read monthly. Older buildings use a Rockwell turbine or compound meters for domestic water. Newer buildings and upgraded water meters use Rosemount Magflow meters. Eventually all domestic water meters on campus will be upgraded.

Throughout the implementation of the university's deferred maintenance program, innovative and low-flow fixtures will be retrofitted, and similarly specified and installed for new construction projects. Examples of fixtures that fit required standards for *Watego* include:

TOILETS

- Toto Flushometer Toilet CT705EN(G), 1.28 GPF when used with High Efficiency Flushometer Valve – commercial floor mounted toilet with elongated front bowl
- Toto Wall-Mounted Flushometer toilet, 1.28 GPF when used with High Efficiency Flushometer Valve – wall-mounted toilet with elongated front bowl
- Toto EcoPower® Toilet Flushometer Valve TET1GA32#CP, 1.6 gpf or less – hydropower self-generating system, sensor activated toilet flush valve.

URINALS

- Toto Low Consumption Washout Urinal UT447E(V), 0.5gpf – compact urinal with concealed integral trap
- Toto EcoPower® Urinal Flushometer Valve TUE1GA22#CP, 1 gpf or less – hydropower self-generating system, sensor activated urinal flush valve.

FAUCETS

- Sloan EAF-275, 0.5 gpm – light powered, sensor activated electric faucet pre-tempered for hot and cold water operation.
- Delta 22C151, 0.5 gpm

Fixture standards will be updated with availability of new technology. It is also understood that the plumbing at the university requires a certain amount of flow so it does not malfunction. Ultra-low flow fixtures may not be feasible at this time.

To date, the Trades Infrastructure and Maintenance (TIM) unit within Asset Management and Operations (AMO) has been managing the implementation of fixture upgrades to existing infrastructure. The potential to hire external contractors to perform fixture upgrades is also a possibility.

4. Projects

Feasibility Studies / Water Audits

When EMSO released the Water Management Plan in 2018, they commissioned a series of water audits in campus buildings to identify potential water conservation measures. Each year EMSO commissions several building water audits as part of its participation in the BOMA BEST rating program and uses the findings to identify potential water savings projects. The savings potential from audits performed between 2018 and 2021 are shown in Table 1.

Table 1. Summary of potential savings from water conservation projects based on water audits in various campus buildings.

	Projected Annual Savings				
Building	**Water (m^3)**	**Natural Gas (GJ)**	**Steam (kg)**	**Electricity (kWh)**	**Cost ($)**
Agriculture Forestry Centre	950		25,000		2,829
Biological Sciences	15,377		52,700		37,847
Gunning/Lemieux Chemistry Centre	3,348		59,600		9,890
Clinical Sciences	2,326		18,100		6,162
Education Centre (N+S)	11,015		63,800		27,814
General Services Building	1,324		29,191		4,040
Humanities Centre	862		12,600		2,447
Medical Sciences Building	28,671		39,900		70,795
CSJ – Residence Saint-Jean	814	164			3,450
CSJ – Pavillon Lacerte	1,415	32			5,000
CSJ – Pavillon McMahon	4,622	58			16,170
Edmonton Clinic Health Academy	1,435		11,000		4,090
Arts / Convocation Hall	981		14,000		2,700
University Hall	149			1,400	480
Assiniboia Hall	489		22,000		1,690
Athabasca Hall	1,067		10,000		2,820
Zeidler Ledcor Centre	631		9,000		1,890
Heritage Medical Research Centre	5,166		151,000		17,477
Li Ka Shing Centre for Health Research Innovation	3,598		188,000		14,928
Augustana Campus	No water conservation recommendations identified				
Natural Resources Engineering Facility	3,743		139,000		14,072
TOTAL POSSIBLE SAVINGS	**87,983 m^3**	**254 GJ**	**844,891 kg**	**1,400 kWh**	**$ 246,591**

Completed Projects

Below is a summary of completed water management projects dating back to 2018 when EMSO developed the original Water Management Plan.

Table 2. Summary of completed water management projects between 2018 and 2021.

		Annual Savings Realized				
Building	**Project Description**	**Water (m^3)**	**Natural Gas (GJ)**	**Steam (kg)**	**Electricity (kWh)**	**Cost**
General Services Building	Washroom fixture upgrades	1,324		29,191		$4,040
Mechanical Engineering Large Scale Fluids Lab	Replaced open loop water use with refrigerant-based cooling system for mechanical engineering pipeline experiments.	4,000				$9,000
Agriculture/Forestry Centre	Washroom fixture upgrades	950		25,000		$2,829
Biological Sciences Building	Fixture upgrades in some building wings	7,689		26,350		$18,924
Medical Sciences Building	Washroom fixture upgrades	28,671		39,900		$70,795
TOTAL SAVINGS REALIZED		**34,945**		**94,091**		**$86,664**

Future Projects

As *Watego* continues, FO will complete fixture upgrades in buildings informed by the water audit recommendations in Table 1, along with building projects that TIM and AMO already have slated for maintenance work. EMSO may conduct additional water audits to identify water savings in buildings slated for maintenance work that have not yet been audited. TIM staff may also make funding suggestions for water savings projects to EMSO for consideration. EMSO will continue to prioritize projects that have Infrastructure Maintenance Program (IMP) funding. *Watego* will also seek to collaborate with other university groups to help fund projects such as lab upgrades, behaviour change initiatives and other innovative water reduction projects.

6. Education, Research and Behaviour Change

Watego is primarily a program based around facilities upgrades and operational components, however in order to increase awareness and promote sustainable behaviours, there is potential under *Watego* to incorporate elements of education, research and behaviour change.

Goals:

- Promote individual responsibility for resource use
- Use appropriate signage to raise awareness about the university's water use and opportunities to positively influence behaviour change
- Meter and display water demands
- Create programs to spark student/public involvement in water-related initiatives/funding opportunities, teaching and research
- Reach out to sustainability groups on campus to create partnerships
- Conduct research on water reuse technologies or collaborate with water researchers to use the campus as a living lab.

7. Conclusion

The *Watego* program will continue its work to reduce the impact of the University of Alberta's facilities on the North Saskatchewan River Watershed and surrounding region. By enhancing the teaching, research and study spaces for its community members, and seeking opportunities to advance industry practices and research in the area of water management, the University of Alberta strives for the betterment of the entire campus and the communities in which it is a part.

8. Acknowledgements

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